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M O U N T A I N G O A T M O V E M E N T S S T U D Y

BY

Lyman Nichols

Volume II

Project Progress Report
Federal Aid in Wildlife Restoration
Project W-21-2, Job No. 12.5R

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Lyman Nichols

Project No.: W-21-2 Project Title: Big Game Investigation

Job No.: 12.5 R Job Title: Mountain Goat Fidelity to Given Area by Season and Seasonal Movements

Period Covered: July 1, 1980 to June 30, 1981

SUMMARY

Twenty-one mountain goats were captured and fitted with radio collars during this report period. Weights and measurements were obtained and are listed. Blood samples were taken; results of analyses to date are also listed. One of the goats originally collared in 1979 died in an avalanche in early summer 1981. Thirty-four goats with functioning radio collars remained in summer 1981.

Twenty-four tracking flights were made during the year. All goat locations were plotted against a base map when they were found. These plots have been digitized and entered into a computer, but not yet analyzed for movement information. Additional data on mortality and production within the collared subpopulation were obtained during tracking.

Population models were constructed from results of aerial surveys conducted on the entire study herd. One hundred and seventy-one goats were estimated in the study area in summer 1980, compared to 246 in summer 1979. As indicated by both the collared sample and population models, mortality was high during winter 1979-80 due to exceptional snowfall and avalanche conditions, but much lower over the winter of 1980-81 which had even heavier snow at high elevations but less extensive avalanching. Reproduction was lower in spring 1980 than in 1979, but improved in 1981.

One ground survey of a portion of the herd was conducted in summer 1980, and goats were classified by sex and age. Results were compared with those from a similar survey in 1979, as well as with aerial surveys of this area.

CONTENTS

BACKGROUND

A major concern of game managers in Alaska is the difficulty of counting mountain goats (Oreamnos americanus) accurately from the air; making the assessment of populations and population changes highly questionable. Previous studies have shown that acceptable accuracy can be obtained from aerial counts conducted under suitable conditions (Ballard 1975, Nichols 1980a). However, on the Kenai Peninsula it was found that goats moved considerable distances between seasonal ranges, and in so doing, crossed count areas or hunting unit boundaries. Furthermore, it was strongly suspected that at least some goats moved from area to area during midsummer when aerial counts were conducted.

Gross movement studies were attempted by aerially dye-marking goats for identification. Although these efforts were relatively inexpensive and successful, the method was useful only for detecting gross movements; individuals could not be recognized or tracked. Also, the dyes used so far have proven too short-lived for serious movement study.

It is apparent that counting inaccuracies will result when unknown movements occur between count areas. Increases or decreases in count results can reflect unknown movements rather than real population changes. Thus, the management biologist does not know the true population sizes within the units for which he issues hunting permits.

Therefore, it is of immediate concern to learn whether such movements are random or predictable; whether the same herds or sub-herds can be expected to occupy a given area during part of the year, or whether their seasonal or intraseasonal movements cannot be predicted. If movements are predictable, censuses can be interpreted properly; otherwise it will be necessary to establish larger count areas to include such movements. If this

is not done, unit management will have to be conservative to take into account the possibility of serious counting errors.

This job has been designed to determine the fidelity of goats to particular areas by time, and hence the predictability of given animals being in a given area at a given season where they may be counted each year. It has also been designed to identify and quantify major seasonal movements by the various sub-segments of the Ptarmigan Lake-Trail/Glacier-King's Bay herd which has been under study, and to learn whether goats move into and out of the study area boundaries. Additional information obtained will indicate mortality causes and rates, home range size of individuals, winter range sizes, and should provide an additional check on the accuracy obtained in aerial censuses.

During the previous reporting period, 20 goats were radio-collared and relocated during each of 18 subsequent tracking flights (Nichols 1980b). One radio collar failed shortly after installation. Of the 19 remaining collared animals, 14 survived the severe winter and avalanches of 1979-80, and continued to be tracked into the current report period.

OBJECTIVES

To determine the seasonal movements of mountain goats in the Kenai Mountains, and to assess the fidelity of goats to given areas within seasons and between years.

PROCEDURES

In August 1980, 3 goats were captured and radio-collared and 18 more were collared in June 1981. One additional goat was captured outside the study area and marked with a colored collar. Capture procedures were as described in the previous segment (Nichols 1980b). Radio collars (Telonics, Inc., Mesa, AZ) were again color-coded with plastic tape so each animal could be identified visually as well as by discrete radio frequency. Weights and measurements were recorded for most of the captured goats. In a few cases measurements could not be made because of hazardous terrain or our inability to lift large animals for weighing. Goats were ear-tagged when captured but not painted for identification as was done previously.

Blood samples were taken from the jugular or, more commonly, the radial vein by means of sterile hypodermic needles and evacuated containers. Two samples were drawn from each goat: 1 in a plain container and 1 in a container containing heparin to prevent coagulation. The plain samples were later spun for approximately 5 minutes in a centrifuge. Serum specimens were then withdrawn and frozen for later laboratory analysis. Hemoglobin and packed cell volume were determined from the uncoagulated samples using a hemoglobin meter and micro-hematocrit centrifuge.

Rectal temperatures and blood pressures were obtained from several of the goats using a standard mercury bulb thermometer and human sphygmomanometer, the latter on the upper foreleg (humerus).

Collared goats were relocated throughout the year using a Telonics programmable receiver-scanner and dual, 3-element Yagi antennae mounted on a Piper PA-18 Supercub airplane. Goat locations were plotted as observed during each flight, and transferred to a base-map overlay following the flight. Tracking and plotting procedures were described in the previous progress report (Nichols 1980b). Just prior to this writing, all goat location-plots were digitized and entered into a computer; no analyses have been conducted as yet.

During each tracking flight, additional information such as mortality, reproduction, snow conditions, associates of collared goats by age class, etc., was recorded on tape and later transcribed. Remains of all but 1 of the collared goats killed by avalanches during the past year were reached in late spring or early summer by ski plane or helicopter, and, when available, bone specimens were collected for marrow-fat analysis. Five radio collars were retrieved in working order and were returned to Telonics, Inc., for refurbishing.

Aerial surveys were conducted over the entire study area on 23 July and 13 and 14 August 1980. Results were combined with the 12 and 31 May 1980 surveys to estimate population size and composition (Nichols 1980a). Another survey was flown on 8 May 1981 to be similarly used in conjunction with summer 1981 counts.

A portion of the herd summering in Ptarmigan Valley was again counted and classified from the ground in 1980 utilizing a Questar telescope. Weather prevented a similar survey in King's Bay as had been done the previous summer.

FINDINGS

Collaring

The capture and collaring procedure worked extremely well. No goats were killed nor injured seriously; only 1 that was darted escaped. He received only a partial injection (the dart bounced out and injected partly into the air), never went completely down, and got into some cliffs where further pursuit seemed inadvisable. All others were captured with 1 dart per goat. Goat reaction time to the capture drug (M-99, etorphine) appeared shorter and more positive in those animals captured in June 1981 than in those captured previously in August 1980. This was probably related to body fat content, which was lower in June. Excellent weather contributed substantially to our success. The only problem encountered was our inability to weigh large males. All but 1 got into such precipitous terrain before capture that

it was impossible to weigh them by hand, or to get the helicopter near enough to weigh them with its electronic scales.

Locations of all goats collared in August 1980 (Nos. 22-24) and June 1981 (Nos. 25-43) have been plotted in Fig. 1. Some were captured outside the boundaries of the study area to learn whether they were actually a part of the study herd. A brief summary by sex and age class of all goats radio-collared to date follows:

Date	Yrlg.M	Yrlg.F	2yr.M	2yr.F	3yr.M	3yr.F	4yr.M	4yr.F	Ad.M	Ad.F
8/79	1	1	1	2	2	1	-	1	3	8
8/80	-	-	-	-	1	-	-	1	1	-
6/81	2	1	1	1	1	3	-	2	3	4
Totals	3	2	2	3	4	4	-	4	7	12

Grand Totals = 41

One additional adult male was captured and fitted with a colored collar (No. 43) so he could be identified from the Seward Highway during the rut.

Serial numbers, accession numbers, sex, age, and other pertinent data from those goats captured in 1980 and 1981 are listed in Table 1. Weights and measurements of all those goats captured to date from which data were obtained are listed in Table 2. Also included are brief notes about those which have died. No analyses of weights and measurements have been undertaken.

Physiological Data

Laboratory analyses of blood specimens taken from goats captured in 1979 have been received, and the various parameters are listed in Table 3. No hemoglobin (Hb) nor packed cell volume (PCV) data were obtained from those animals. No blood samples were procured from the 3 animals collared in 1980. Laboratory analyses of the serum samples collected in 1981 have not yet been received. However, Hb and PCV values for these goats were determined and are listed in Table 4.

Rectal temperatures of several captured goats were taken. Since these animals had been stressed and were under the influence of a strong narcotic, it is unknown whether these temperatures are representative of mountain goats under normal circumstances. Blood pressure readings were attempted using a standard human sphygmomanometer cuff on the upper foreleg and a stethoscope on the brachial artery. Several apparently accurate readings were obtained but those taken on a large male were variable and uncertain due to heavy coat and musculature. These readings, plus 1 pulse rate are listed in Table 5. The same uncertainty applies to these values as to their applicability to normal, healthy goats.

Fig. 1. Study area boundary and locations where goats were collared in August 1980 and June 1981.

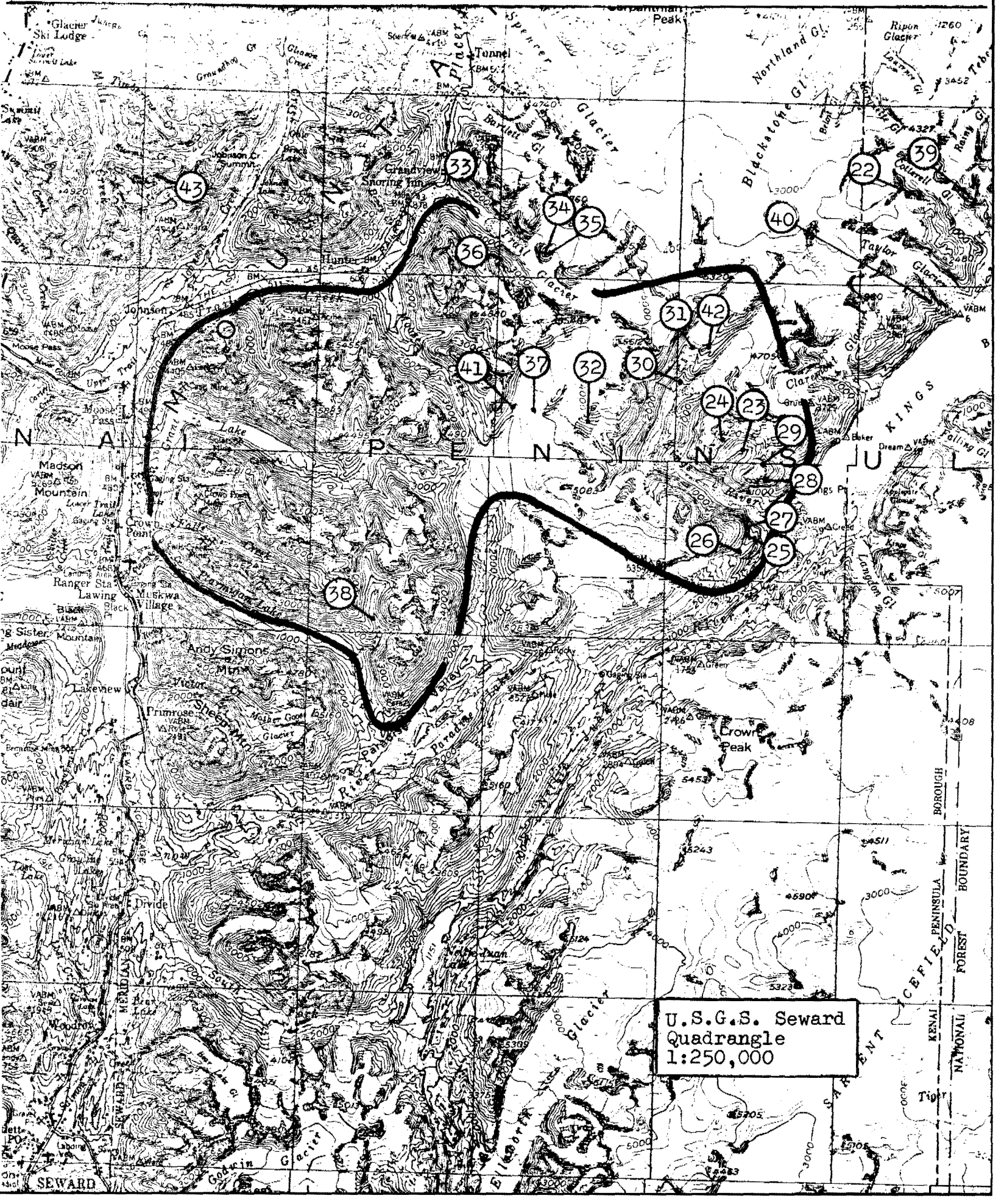

Table 1. List of mountain goats collared on 20 August 1980 and 16-20 June 1981.

Serial Number	Accession Number	Sex	Age	Reprostat	Collar frequency MHz	Ear Tag No. R	Ear Tag No. L	Drug Dosage ml	Time to 1/ to down	Antidote dosage ml	Time to recover
22(80)	73522	M	3	-	150.941	-	-	5.0	6.5 min	5.0	1.6 min.
23(80)	73523	M	12	-	150.850	40	-	5.0	9.9 min.	5.0	15 + min.
24(80)	73524	F	4	no kid no prior kid	151.376	-	-	4.0	12 min.	4.0	15 + min.
25(81)	73525	F	3	no kid no prior kid	150.726	701	-	4.0	5 min.	4.0	3 min.
26(81)	73526	F	3	no kid no prior kid	150.951	702	-	4.0	6 min.	4.0	0.7 min.
27(81)	73527	M	1	-	150.875	707	-	4.0	-	4.0	-
28(81)	73528	M	2	-	151.026	-	708	4.0	8 min.	4.0	-
29(81)	73529	M	9	-	150.974	745	-	4.0	-	4.0	-
30(81)	73530	M	7	-	150.181	-	744	4.0	-	4.0	-
31(81)	73531	F	1	no kid no prior kid	150.897	743	-	4.0	-	4.0	-
32(81)	73532	F	4	no kid no prior kid	150.171	-	748	4.0	-	4.0	1.3 min.
33(81)	73533	M	1	-	150.998	749	-	4.0	5 min.	4.0	-
34(81)	73534	F	8	with kid	150.120	-	727	4.0	3.5 min.	4.0	1.3 min.
35(81)	73535	F	8	with kid	151.035	-	726	4.0	6.1 min.	4.0	1.8 min.
36(81)	73536	M	6	-	151.063	737	-	4.0	9.9 min.	4.0	-
37(81)	73537	F	4	no kid no prior kid	151.700	728	-	4.0	9.8 min.	4.0	0.8 min.
38(81)	73538	F	12	with kid	151.611	-	750	4.0	9.8 min.	4.0	-
39(81)	73539	F	2	no kid no prior kid	150.826	747	-	4.0	5.5 min.	4.0	1.3 min.
40(81)	73540	M	3	-	151.631	-	746	4.0	-	4.0	-
41(81)	73541	F	3	no kid no prior kid	150.910	-	736	4.0	6.8 min.	4.0	-
42(81)	73542	F	7	Apparently lost kid recently	150.801	739	-	4.0	2.0 min.	4.0	-
43(81)	73543	M	7	-	(non-radio collar)	-	729	5.0	-	5.0	-

1/ Not all drug reaction times were recorded; most recovery times were about 1-2 minutes.

Table 2. Measurements of goats collared in August 1979, August 1980, and June 1981. Lengths in cm; weights in lb.

Serial No.	Sex	Age	Weight	Total length	Head	Ear	Tail	Hind Foot	Shoulder Height	Chest Girth	Neck Girth	Horn Length R	Horn Length L	Notes
1(79)	F	2	118	148.0	25.0	10.0	7.0	30.0	76.0	96.0	40.0	-	17.2	
2(79)	F	7	166	153.0	28.0	10.0	8.5	32.0	87.0	110.0	40.0	-	22.8	Killed by avalanche during winter '79-'80
3(79)	F	4	157	160.5	27.0	10.0	6.5	32.0	83.0	110.0	37.0	23.0	-	
4(79)	F	2	134	137.0	24.0	10.0	6.0	32.0	77.0	97.0	38.0	9.5	-	
5(79)	M	5	280+	167.0	29.0	10.5	10.0	34.5	106.0	127.0	49.0	-	22.0	Unable to obtain full weight
6(79)	M	2	162	153.0	26.0	10.0	9.0	34.0	86.0	102.0	36.0	20.0	-	Collar failed after 2 months
7(79)	F	3	171	161.0	27.0	10.5	12.0	30.0	82.0	106.0	38.0	22.0	-	Killed by avalanche in spring 1981
8(79)	F	9	187	157.0	27.0	10.0	9.5	32.5	84.0	109.0	40.0	22.9	-	Killed by avalanche during winter '78-80
9(79)	F	8	167	145.0	26.0	9.5	9.0	31.5	83.0	102.0	37.0	23.33	-	
10(79)	F	9	173	159.0	26.5	10.0	10.5	33.0	84.0	109.0	39.0	24.0	-	Eaten by bear in early spring '80
11(79)	F	5	168	158.0	26.5	10.0	9.5	32.0	86.0	104.0	37.0	-	23.0	
12(79)	F	1	100	126.0	22.5	9.5	9.0	29.5	72.0	89.0	31.0	-	11.3	
13(79)	M	10	300+	169.0	28.5	10.0	9.5	34.0	96.0	131.0	47.0	-	22.5	Estimated weight. killed by avalanche
14(79)	M	1	122	131.0	22.5	10.0	7.5	30.0	78.0	91.0	36.0	16.0	-	

Table 2. (cont'd)

Serial No.	Sex	Age	Weight	Total length	Head	Ear	Tail	Hind Foot	Shoulder Height	Chest Girth	Neck Girth	Horn Length R	Horn Length L	Notes
15(79)	M	3	195	161.0	28.5	10.0	8.0	35.0	92.0	117.0	42.0	22.7	-	
16(79)	F	7	171	156.0	26.0	10.0	7.0	31.0	86.0	104.0	39.0	-	24.0	
17(79)	M	3	-	-	-	-	-	-	-	-	-	-	21.8	Over cliff. No measurement. Killed by avalanche
18(79)	M	8	-	165.0	29.0	11.0	11.0	35.5	94.0	132.0	46.0	21.5	-	
19(79)	F	5	163	157.0	25.5	10.0	9.0	31.5	82.0	110.0	37.0	-	20.4	
20(79)	F	6	158	161.0	27.0	10.0	10.0	31.5	84.0	110.0	38.0	23.4	-	
22(80)	M	3	-	160.0	25.0	10.3	9.5	34.0	84.0	114.0	46.0	21.0	20.0	
23(80)	M	12	-	179.0	29.0	11.0	9.0	35.0	97.0	138.0	51.0	21.0	21.0	
24(80)	F	4	-	144.0	-	-	-	-	-	101.0	35.0	19.5	-	
25(81)	F	3	120	149.0	25.0	10.0	12.0	33.0	80.0	95.0	33.0	22.1	-	
26(81)	F	3	107	142.0	24.0	9.5	9.5	32.0	74.0	91.0	33.0	17.3	-	
27(81)	M	1	87	134.0	22.0	9.5	8.0	31.0	77.0	83.0	33.0	-	14.5	
28(81)	M	2	120	149.0	26.0	10.0	10.0	35.0	76.0	96.0	37.0	-	21.0	
29(81)	M	9	-	174.0	29.5	11.0	10.0	35.5	94.0	128.0	48.0	24.8	-	Unable to obtain weight
30(81)	M	7	-	163.0	29.0	11.0	12.0	35.0	96.0	128.0	48.0	-	22.0	Unable to obtain weight
31(81)	F	1	75	124.0	21.0	9.0	7.0	29.0	66.0	85.0	29.5	-	9.4	
32(81)	F	4	115	150.0	26.0	10.0	11.5	31.5	83.0	99.0	39.0	-	20.3	
33(81)	M	1	92	121.0	22.0	9.5	9.5	31.0	70.0	82.0	31.0	13.3	-	

Table 2. (cont'd)

Serial No.	Sex	Age	Weight	Total length	Head	Ear	Tail	Hind Foot	Shoulder Height	Chest Girth	Neck Girth	Horn Length R	Horn Length L	Notes
34(81)	F	8	110	152.0	25.0	9.5	9.0	31.5	78.0	106.0	47.0	22.2	-	With heavy winter coat intact
35(81)	F	8	115	160.0	26.0	10.0	8.0	32.0	83.0	100.0	39.0	-	21.3	With heavy winter coat intact
36(81)	M	6	190	162.0	28.0	11.0	12.0	35.0	95.0	115.0	43.0	-	23.1	
37(81)	F	12	105	142.0	25.5	10.5	10.0	30.2	75.0	92.0	32.0	20.7	-	
38(81)	F	12	130	156.0	26.5	10.0	10.0	32.0	83.0	101.0	39.0	-	23.3	With heavy winter coat intact
39(81)	F	2	120	146.0	25.0	10.0	9.0	32.0	75.0	91.0	35.0	17.3	-	
40(81)	M	3	-	-	-	-	-	-	-	-	-	-	22.3	No other measurements taken
41(81)	F	3	120	141.0	25.0	10.0	9.5	32.0	80.0	92.0	32.0	-	19.0	
42(81)	F	7	125	158.0	26.5	10.0	12.0	33.0	79.0	106.0	35.0	25.2	-	
43(81)	M	7	-	-	-	-	-	-	-	-	-	-	-	No measurements Non-radio collar

Table 3. Blood parameters from mountain goats collared in August 1979.

Accession Number	Sex	Age	Glucose (mg/dl)	BUN (mg/dl)	Creatinine (mg/dl)	Nat (mEq/L)	K+ (mEq/L)	Cl- (mEq/L)	CO_2 (mEq/L)	Uric Acid (mg/dl)	Total Bilirubin (mg/dl)	Direct Bilirubin (mg/dl)	Electrolyte Balance (N/A)	Ionized Calcium (mg/dl)	
73501	F	2	199	23	1.2	134	6.2	91	18	0.9	0.1	0.1	15.0	4.4	1
73502	F	7	99	27	1.4	148	5.1	103	18	0.7	0.2	0.1	17.0	4.4	1
73503	F	4	136	23	1.6	141	5.4	96	16	0.7	0.2	0.1	19.0	4.8	1
73504	F	2	135	21	1.9	143	5.8	96	7	0.8	0.2	0.1	30.0	5.2	1
73505	M	5	182	24	1.8	141	5.5	95	10	0.8	0.2	0.1	26.0	4.5	1
73506	M	2	176	16	1.3	117	4.4	76	4	0.7	0.1	0.0	27.0	4.4	
73507	F	3	123	21	1.4	144	4.8	96	7	0.6	0.1	0.1	31.0	4.7	1
73508	F	9	102	19	1.1	128	5.2	87	11	0.4	0.1	0.0	20.0	3.8	
73509	F	8	124	16	1.5	145	5.6	94	7	1.1	0.1	0.1	34.0	4.7	1
73510	F	9	69	40	1.7	139	6.0	93	11	1.1	0.2	0.1	25.0	4.2	1
73511	F	5	83	35	1.6	139	6.5	91	13	1.1	0.3	0.1	25.0	4.2	1
73512	F	1	91	34	1.2	141	5.5	95	17	0.6	0.2	0.1	19.0	4.8	1
73513	M	10	163	22	1.8	141	4.6	98	21	0.4	0.4	0.1	12.0	4.2	1
73514	M	1	44	25	1.1	145	4.4	92	10	0.7	0.2	0.1	33.0	4.7	1
73515	M	3	101	21	1.3	143	4.2	95	9	0.7	0.2	0.0	29.0	4.2	1
73516	F	7	50	26	1.3	140	4.8	90	14	0.5	0.1	0.1	26.0	4.3	1
73517	M	3	101	18	1.5	142	4.8	96	18	0.6	0.2	0.0	18.0	4.6	1
73518	M	8	93	27	1.8	144	4.8	98	16	0.6	0.2	0.0	20.0	3.8	1
73519	F	5	78	22	1.6	143	6.2	98	5	1.2	0.2	0.1	30.0	4.4	1
73520	F	6	163	29	1.3	139	5.0	94	6	0.7	0.1	0.1	29.0	4.4	1

1/ + sign indicates reading was above accuracy level of the instrument.

Table 4. Blood parameters from goats collared in June 1981.

Accession Number	Sex	Age	Packed Cell Volume (%) (PCV)	Hemoglobin (g/100 ml) (Hb)
73525	F	3	36.0	16.7
73526	F	3	35.0	15.9
73527	M	1	28.0	13.5
73528	M	2	37.0	16.0
73529	M	9	40.0	16.9
73530	M	7	40.5	17.9
73531	F	1	-	-
73532	F	4	32.0	16.0
73533	M	1	43.0	20.5
73534	F	8	30.0	13.9
73535	F	8	38.0	19.0
73536	M	6	41.0	19.0
73537	F	4	39.0	18.0
73538	F	12	39.0	19.0
73539	F	2	34.0	15.4
73540	M	3	37.0	16.9
73541	F	3	33.0	15.4
73542	F	7	37.0	15.0

Table 5. Rectal temperatures and blood pressures of captured goats.

Serial No.	Sex	Age	Rectal Temperature (°F)	Minutes after Capture	Blood Pressure (mmHg)	Minutes after Capture
25	F	3	106.3	30	100/80	35
					96/74	40
					94/80	45
27	M	1	106.4	40		
28	M	2	105.2	10		
29	M	9	102.9	45	122/94 1/	60
					138/86	61
					118/84	63
					104/74	66
32	F	4	104.8	45	(Pulse:108)	
37	F	4	105.3	?	108/78	?

1/ Difficulty in obtaining good reading on this animal due to size of upper foreleg and heavy musculature.

Radio-tracking

Twenty-four radio-locating flights were made during this reporting period. On nearly every flight, all collared goats were located and plotted. Flights were made at intervals throughout the year to locate animals in all seasons. One of the goats collared outside the assumed boundaries of the study herd spent winter 1980-81 with other animals within these boundaries. Most of the collared goats spent winters 1979-80 and 1980-81 in the same areas, but summer movements were less predictable. No adequate conclusions regarding movements can be drawn until computer analysis is completed.

Reproduction

Table 6 lists the numbers and percentages of captured goats by age class which had kids at heel, or showed definite indications of having given birth the summer of capture.

In this small subpopulation of captured goats, it appears that no females reproduced successfully before age 4, and all give birth from 6 through 12 years of age. This is contrary to the generally held belief that female mountain goats first breed at age 2½ and have their first kids at age 3 (Foss 1962, Chadwick 1973). In this case, small sample size may have influenced the results, or it may be that this herd is nutritionally stressed and suffers from slow growth and late maturity.

Reproductive success, as indicated by the percentage of females over 4 years old among the collared goats that gave birth (as evidenced by kids-at-heel or external physical signs: swollen udder and vulva) and then raised their young into the summer is shown in Table 7.

Mortality

Winter 1979-80 produced a record snowpack and subsequent numerous avalanches in the study area and surrounding mountains (Clagett et al. 1980). Snowfall was even heavier at higher elevations in winter 1980-81, setting another record (Anonymous 1981, Clagett pers. commun.) but spring avalanches were not as severe as the previous winter. Nineteen collared adults with 5 kids were present at the start of winter 1979-80. Of these, 4 adults and 2 kids were known to have been killed by avalanches: 60% of all known mortality. Another adult was killed by a brown bear (*Ursus arctos*), and 3 kids died of unknown causes. Winter mortality, including predation, was 26% for non-kids, 100% for kids, and 42% for the collared population as a whole.

The next winter, 1980-81, 17 adults and 3 kids were present at the onset of winter. One adult female was killed by a late spring avalanche in early June 1981 (she was pregnant), and her previous year's kid died of unknown causes earlier. These were the only mortalities among the collared goats despite the record

Table 6. Reproduction by age class among captured female goats, 1979, 1980, 1981.

Age in Years	No. in Age Class	No. Having Kids or Having Had Kids	Percent Having Kids or Having Had Kids 1/
1	2	-0-	-0-
2	4	-0-	-0-
3	7	-0-	-0-
4	5	2	40
5	5	4	80
6	6	6	100
7	5	5	100
8	5	5	100
9	4	4	100
10	1	1	100
11	-0-	-0-	-0-
12	1	1	100

1/ Two adult nannies showed definite signs of having given birth and then losing their kids before capture. Other females without kids showed no external signs of ever having had any.

Table 7. Reproductive success among collared female goats over age 4.

Year	No. having had kid	Percent	No. having live kid after parturition season	Percent
1979	7 1/	88	6	75
1980	4	50	3	38
1981	11	73	10	67

1/ One female had twins when captured, making a total of 8 kids. These kids died of unknown causes after capture of nanny but before winter.

high-elevation snowpack. Thus, mortality rates were 6% for non-kids, 33% for kids, and 10% overall.

Within the study area, most of the winter mortality occurred in the Moose Creek drainage. One adult and 1 kid died in King's River drainage, 1 kid in Trail Glacier drainage, and 1 adult in Falls Creek. Another kid may have died on Ptarmigan Lake slope. Snowpack appeared heaviest in Moose Creek, King's River, and Trail Glacier; lighest along Grant and Ptarmigan Lake slopes. Avalanching was bad in all areas in winter 1979-80, less severe in all areas the next year.

Post-mortem Results

During a radio-tracking flight on 8 May 1980, 2 dead females were located in areas reachable by ski plane. The 1st was No. 73510, a collared goat aged 9 years 11 months, which was eaten, and probably killed by a large brown bear near the valley floor of Moose Creek. Portions of the metatarsus, metacarpus, and tibia were recovered. Marrow from these bones was later analyzed in the laboratory (Neiland 1970) and found to contain 7.5-8.2% fat. The second animal, No. 73521, an uncollared female aged 7 years 11 months, was located by tracks in the snow. She appeared to have wandered along the Trail Glacier valley floor in deep snow a few days before being found and died leaning against a rock outcrop. Her femur contained only 4.2% marrow fat. Both animals' fat levels were extremely low, indicating severe malnutrition. The second goat weighed 90 lbs when found. This represents a weight loss of about 46% from the average weight, in August, of 168 lbs for 3 adult females aged 7-8 years. This animal was examined grossly for pregnancy when found. Although decomposition made results uncertain, it appeared to have been resorbing a fetus. Other collared goats killed by avalanches during winter 1979-80 were not recovered in time for examination before being eaten by scavengers.

Goat No. 73507, a 5-year-old collared female killed in an avalanche in early June 1981, was found to be pregnant when her remains were recovered several weeks later. Her femur marrow fat level was 38.5%. It is unknown what levels of marrow fat should be expected in adult mountain goats following average winters, but this goat must have been in better condition than those examined during the previous winter, suggesting a somewhat better nutritional status and easier winter in this part of the study area.

Aerial Survey Results

Results of the 2 aerial surveys conducted during this reporting period and the 1 conducted previously which had been used to construct a current population model, are shown in Table 8. Because of the late spring in 1980, and late movements to summer range, it was not possible to classify adult males on the basis of early summer grouping as previously suggested (Nichols 1980a).

Table 8. Results of aerial surveys conducted on study area during this segment.

Date	Total	Total Adults 1/	Yearlings	Kids
5/12/80 2/	122	122	21 (17% of TA)	-
7/23, 8/13, 8/14/80	154	127	-	27
5/8, 5/25/81	97	97	20 (21% of TA)	-

1/ Total Adults (TA) = Total non-kids-of-year.
2/ Conducted during previous segment, but used in current population model estimation.

Table 9. Estimated population models for study area during summers of 1979 and 1980, and calculated mortalities.

Year	Ad.M	Ad.F	Ad.M + AD.F	2 yr	Yrl	Kid	TA	Total
1979	59	89	148 ± 3	18 ± 3	25	55	191	246
								-6 1/
						-56% 3/		240
							-41% 3/	
1980	- 2/	-	100 ± 3	16 ± 3	24	30	141	171

1/ Approximate hunter harvest in study area
2/ Adult males (Ad.M) could not be classified due to late-season counts; therefore, adult females (Ad.F) could not be estimated.
3/ Estimated overwinter mortality of kids and entire herd.

Thus, the estimated population model for the study herd in summer 1980 is incomplete when compared with that for 1979 (Table 9). Without an estimate of adult males in the herd, an estimate of adult females could not be made. However, the model does estimate the number of yearlings present (based on the proportion observed in the May 1980 survey) and the number of 2-year-old animals present, based on the number of yearlings in 1979 and overwinter mortality of kids (Nichols 1980a).

Overwinter mortality of 1979 kids to 1980 was estimated to have been 56% in the herd as a whole, compared with 100% for the collared sample. Overall mortality was about 41% (exclusive of hunter-harvest in 1979), compared with 42% for the collared animals. Mortality of goats older than kids overwintering in the whole herd is estimated at about 37%, compared with 26% in the collared portion. The collared goats and their kids, representing a sample equal to 10% of the entire post-hunting study herd, suffered about equal overall winter mortality as the entire herd, but higher kid and lower adult mortality during this exceptionally severe winter.

The May 1981 aerial survey was conducted to obtain the proportion of yearlings surviving the winter. Results will be used in constructing a summer 1981 population model in the next progress report.

Reproductive success, as calculated from the 1979 population model, was 62 kids per 100 females over 2 years of age. This compares with 78 kids per 100 females over 2 years old in the captured sample. No estimate could be made in 1980 for the population as a whole since females over 2 years old could not be classified. In the collared sample, reproductive success in 1980 was 33 kids per 100 females over 2, a sharp drop from that in 1979.

A poor, but commonly used indicator of reproductive success is the ratio of kids to total adults (non-kids). This ratio does not take into account the composition of the adult segment, which can alter drastically the actual ratio of kids to reproducing females. However, unless classification can be accomplished, it may be the only available indicator. Ratio of kids per 100 adults in 1979 and 1980 for both the entire study population and the collared sample were:

	Kids per 100 adults	
Year	Population model	Collared sample
1979	29	34
1980	21	18

These methods indicate sharply decreased reproductive success in 1980, undoubtedly resulting from the severe winter of 1979-80 and the consequent late spring in 1980.

Ground Survey Results

A portion of the herd which summers in Ptarmigan Valley was counted and classified from the ground in 1979 and 1980. Results are shown in Table 10, along with results of the aerial surveys covering that area only. Calculated overwinter mortalities of both kids and the sample as a whole were lower than those estimated for the entire herd. In conjunction with the locations of known mortalities, and the observed snowfall pattern, this suggests again that milder winter conditions prevail in the Ptarmigan Lake vicinity than in the northern and eastern parts of the study area.

Ratios of kids to adults and kids and yearlings to females over 2 years of age (Ad.F) were calculated from the ground survey results in Ptarmigan Valley as follows:

Year	Kids:100 Adults	Kids:100 Ad.F	Yrl:100 Ad.M
1979	31	77	69
1980	23	47	53

Unfortunately, ratios of kids and yearlings per adult female, ratios which are good indicators of reproductive success and juvenile survival, could not be calculated for the entire herd. Those from Ptarmigan Valley are probably higher than would be found in the whole herd because it is primarily a summering area for females and young, as well as representing that portion of the herd undergoing the mildest wintering conditions.

RECOMMENDATIONS

1. That radio-tracking be continued as long as radio collar batteries last.

2. That several young female goats, first captured in 1979, be recaptured and recollared when their present batteries run down to enable further reproductive information to be obtained.

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Table 10. Results of ground and aerial counts in Ptarmigan Valley, summers of 1979 and 1980.

Method	Date	Ad.M	2-yr-M	2-yr-F	Yrl	Ad.F	K	TA	T
Ground	7-19-79	2	5	3	9	13	10	32	42
						-20%			-29%
Ground	7-30-80	2	3	2	8	15	7	30	37
Air	6-15-79	-	-	-	-	-	9	30	39
									-26%
Air	7-23-80	-	-	-	-	-	8	29	37

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